

Remarks/Arguments

Claims 1, 5, 9-42, 44-49, 52, 54-56 and 58 are pending in the above-captioned application. Claims 3, 4, 6, 7, 50 and 57 have been cancelled without prejudice or disclaimer herein. Claims 1, 5, 9, 27, 33-36 and 52 are sought to be amended. New claim 58 is sought to be added. The claim amendments and new claim 58 introduce no new matter and support is replete throughout the specification. Specifically, support for the amendments to claims 1, 5, 9, 27, 33-36 and 52 and for new claim 58, can be found in claims 6 and 9 as originally filed; in the specification at page 12, paragraph 41, through page 15; and at pages 17-18, paragraph 57. These amendments are made without prejudice to renewal of the claims in their original form and are not to be construed as abandonment of the previously claimed subject matter or agreement with any objection or rejection of record.

I. Rejection Under 35 U.S.C. §103(a) in view of Koyama, Avouris and Majumdar

Claims 1, 3-7, 9-42, 44-49, 52 and 54-56 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over allegedly admitted prior art (Figures 1 and 2 and paragraphs 3-8 of the present specification) in view of Koyama *et al.*, U.S. Published Patent Appl. No. 2002/0024489 (hereinafter "Koyama"), Avouris *et al.*, U.S. Published Patent Appl. No. 2004/0061422 (hereinafter "Avouris") and Majumdar *et al.*, U.S. Patent No. 6,882,051 (hereinafter "Majumdar"). By the foregoing amendments, claims 3, 4, 6 and 7 have been cancelled. Hence, the portion of the rejection that may have applied to these has been rendered moot. Applicants respectfully traverse this rejection as it may apply to the remaining claims.

The Examiner asserts that the allegedly admitted prior art discloses an active matrix backplane used with a display comprising a plurality of pixels and pixel transistors. The Examiner states that the allegedly admitted prior art does not disclose that each pixel transistor is a nanowire transistor. However, the Examiner states that Koyama discloses the use of field-effect transistors as switching elements in active matrix displays. The Examiner further asserts that, based upon the disclosure of Avouris, it was well known that field-effect transistors can comprise nanowire transistors. The Examiner

assets that it would have been obvious to utilize the nanowires disclosed in Avouris in the field-effect transistors disclosed in Koyama in active matrix displays simply because this would reduce the space requirement on a chip. The Examiner further asserts that it would have been obvious to utilize the core-shell nanowires disclosed in Majumdar so as to provide a high performance energy conversion device. The Examiner therefore concludes that the present invention is rendered obvious. Applicants respectfully disagree with the Examiner's conclusions and the assertions on which they are based.

Present claim 1 (and hence, claims 5, 9-26 and 54-55 that depend ultimately therefrom and that are also rejected) recites an active matrix backplane comprising a plurality of nanowire transistors, each of which comprises an average number of nanowires sufficient to at least charge and discharge a respective pixel at a desired rate. Similarly, present claim 27 (and hence, claims 28-49 and 56 that depend ultimately therefrom and that are also rejected) recites a liquid crystal display have a base substrate comprising a plurality of nanowire transistors, each of which comprises an average number of nanowires sufficient to at least charge and discharge a respective pixel at a desired rate. Finally, present claim 52 recites an active matrix backplane used within a display comprising a plurality of nanowire transistors, each of which comprises an average number of nanowires sufficient to at least charge and discharge a respective pixel at a desired rate.

Applicants respectfully submit that the Examiner has provided no motivation to combine the disclosures of Koyama, Avouris and Majumdar. Simply because Koyama may disclose the use of field-effect transistors in active matrix displays, there is no evidence that the ordinarily skilled artisan would, or even could, utilize the nanowire transistors disclosed in Avouris in such applications. The Examiner has not pointed to any disclosure, either in Koyama, Avouris, or knowledge available in the art, that would motive one of ordinary skill in the art to adapt the transistors disclosed in Avouris for use as field-effect transistors in active matrix displays.

Avouris provides no indication that the single nanotube transistors disclosed therein could be applied to use in active matrix displays. Throughout Avouris, the disclosed transistors are referred to in the context of simple, light emitting diodes

(LEDs) (*see, e.g.,* Avouris at page 1, paragraph 6; at page 3, paragraph 42; and at page 3, throughout the claims). The ordinarily skilled artisan would not have been motivated to utilize the LED transistors disclosed in Avouris in the active matrix disclosed in Koyama. Furthermore, Applicants respectfully submit that there is no reasonable expectation of success that the single nanotube transistor disclosed in Avouris would even function in the active matrices disclosed in Koyama. Avouris discloses the use of a single nanotube in the construction of an LED (*see* Avouris at page 2, paragraph 31 "single molecule device;" at page 2, paragraph 38 "[t]he prototype device comprises a single carbon nanotube"). Applicants respectfully submit that there is no reasonable expectation that a single nanotube functioning as an LED could be used in the active matrix structure required by Koyama, or required by the presently claimed invention.

The presently claimed invention requires nanowire transistors that have an average number of nanowires sufficient to at least charge and discharge a respective pixel at a desired rate. Disclosure of a transistor comprising a single carbon nanotube for use in an LED does not enable one of skill in the art to utilize such transistors in active matrices. The Examiner states "it has been held that discovering an optimum value, range, location, material of a result effective variable involves only routine skill in the art." Office Action at page 4, lines 18-20. Applicants respectfully disagree with the Examiner. As noted throughout the present specification, Applicants have provided detailed information on the calculations required to determine the number, size and composition of nanowires required to provide sufficient charging and discharging necessary in transistors for use in active matrix backplanes. Applicants respectfully submit that these determinations are not routine. In contrast, Applicants submit that, at the time of filing of the present application, the use of nanowire-based transistors in active matrix backplanes was unpredictable and significantly uncharacterized. As stated in the present specification at page 4, paragraph 41, lines 1-4, "[t]he inventors developed a nanowire LCD design tool to demonstrate the feasibility of using nanowire transistors for the electronics driving the liquid crystals within pixels of an LCD." Applicants respectfully submit that, prior to the present invention, use of nanowires in such configurations was far from routine, and in fact, would have required significant

inventive effort to determine the required characteristics (i.e., number, orientation, configuration, composition) for the nanowires to function in such active matrix backplanes. Applicants respectfully submit that this level of enabling disclosure is absent from all of the art cited by the Examiner.

Avouris' disclosure of a single nanotube that acts as a light emitting diode provides no motivation, no reasonable expectation of success, and is clearly not enabled for use as transistors in active matrix backplanes (which may require greater than 100 nanowires), as disclosed in Koyama, and as required in the presently claimed invention. Therefore, Applicants respectfully submit that the Examiner has not established a *prima facie* case of obviousness based on the disclosures of Koyama and Avouris.

In addition, Applicants respectfully submit that the ordinarily skilled artisan would have no motivation to utilize the core-shell nanowire structures disclosed in Majumdar in the nanotube light emitting diodes of Avouris, much less in a transistor for use in an active matrix as required by Koyama. Simply because core-shell nanowires exist, the ordinarily skilled artisan would not have been motivated to substitute them for the nanotubes disclosed in Avouris, or to use them in transistors. The Examiner has provided no indication in any of the references, or in the knowledge available in the art, to make such a substitution. Therefore, Applicants respectfully submit that the Examiner has not established a *prima facie* case of obviousness.

Therefore, in view of the foregoing remarks, Applicants submit that claims 1, 3-7, 9-42, 44-49, 52 and 54-56 are not rendered obvious. Reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a) are respectfully requested.

II. Rejection Under 35 U.S.C. §103(a) in view of Koyama, Roesner and Majumdar

Claims 50 and 57 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over allegedly admitted prior art (Figures 1 and 2 and paragraph 3-8 of the present specification) in view of Koyama, Roesner *et al.*, U.S. Published Patent Appl. No. 2003/0132461 (hereinafter "Roesner") and Majumdar. By the foregoing amendments, claims 50 and 57 have been cancelled. Hence, this rejection has been rendered moot.

However, Applicants wish to provide the following comments with regard to Roesner. As noted above, the presently claimed invention recites that the various nanowire transistors utilized in the present invention comprise an average number of nanowires sufficient to at least charge and discharge a respective pixel at a desired rate. Applicants submit that Roesner does not disclose the use of nanowires in transistors where the nanowire transistors comprise an average number of nanowires sufficient to at least charge and discharge a respective pixel at a desired rate, specifically for use in an active matrix setting. There is no disclosure in Roesner that the nanowire transistors disclosed therein could be used in active matrix settings.

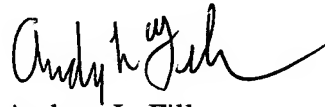
In addition, Roesner does not enable the ordinarily skilled artisan to utilize nanowire transistors in active matrices where an average number of nanowires sufficient to at least charge and discharge a respective pixel at a desired rate are required. As discussed throughout the present specification, Applicants have determined the characteristics of nanowire transistors that allow for sufficient charging and discharging of a respective pixel at a desired rate, including size, number and composition of the nanowires. Roesner provides no disclosure of the requirements necessary to utilize nanowire transistors in such applications, nor does Roesner enable one of ordinary skill in the art to construct the required nanowire transistors (for example transistors with large numbers of nanowires). Hence, Applicants respectfully submit that Roesner cannot, and does not, render the presently claimed invention obvious.

III. Conclusion

All of the stated grounds of rejection have been properly traversed, rendered moot or otherwise overcome. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and that they be withdrawn.

Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. Prompt and favorable consideration of this Amendment and Reply are respectfully requested.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Andrew L. Filler", with a stylized flourish extending to the right.

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